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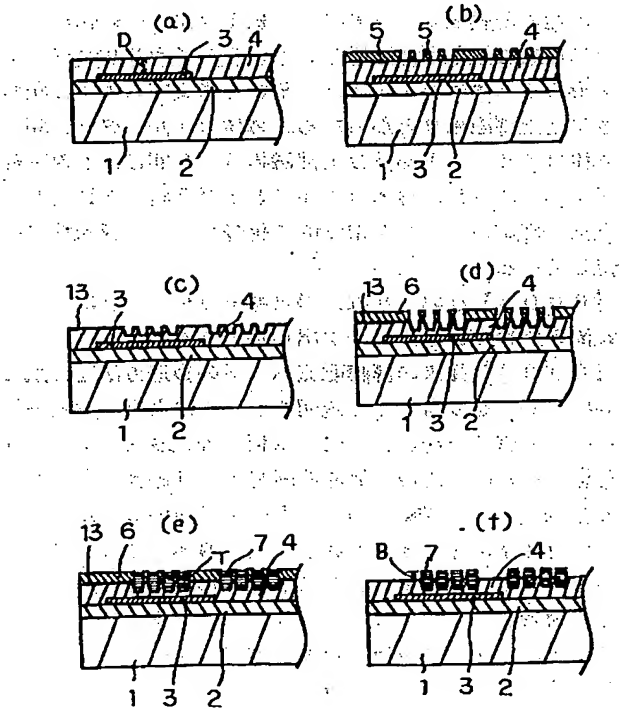
(54)【発明の名称】　薄膜磁気ヘッドの製造方法

(57)【要約】

【目的】　薄膜磁気ヘッドの製造方法において、膜厚の厚いコイルの無機絶縁材等による埋め込みを容易にし空洞の発生をなくす。

【構成】　下部磁極３を無機絶縁層４で埋め込んだ後、無機絶縁層４に導体コイルの反転パターンを施し、また、ネガ型レジストを用いて導体コイル形成のメッキ用フレーム６を形成し、導体コイル７の厚さを無機絶縁層のコイル反転パターンの凹部の深さより厚く形成する。

【効果】　薄膜磁気ヘッドのコイル形状が狭間隔、膜厚化してもコイル間の絶縁材埋め込みができ、薄膜磁気ヘッドの再生感度が向上できる。



【特許請求の範囲】

【請求項１】基板上の上部磁極と下部磁極にはさまれた無機絶縁層及び導体コイルを有する薄膜磁気ヘッドの製造方法において、(a) 下部磁極を無機絶縁材で埋め込んだ後、該無機絶縁材を導体コイルの反転パターンにエッチングする工程と、(b) 上記(a) 記載の反転パターンと同一のパターンを該パターンと一致させてネガ型レジストを用いて形成する工程と、(c) 上記(a) (b) 記載の反転パターンをフレームとして導体コイルをメッキ法により形成する工程とを有することを特徴とする薄膜磁気ヘッドの製造方法。

【請求項２】請求項１記載の薄膜磁気ヘッドの製造方法において、導体コイルの厚さの導体コイル間隔に対する比が１以上の導体コイルを(a) 導体コイルの厚さを該無機絶縁層に形成された導体コイルの反転パターンの溝部の深さより厚く、かつ、(b) 該無機絶縁層の導体コイルの反転パターンの溝部よりも厚く形成された導体コイルの溝部よりも突出した部分の厚さの導体コイル間隔に対する比を１以下にメッキして形成することを特徴とする薄膜磁気ヘッドの製造方法。

【請求項３】請求項２記載の溝部深さより厚く形成された導体コイルの溝部よりも突出した部分をスパッタ法により無機絶縁材で埋め込むことを特徴とする薄膜磁気ヘッドの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、薄膜磁気ヘッドの製造方法に関する。

【０００２】

【従来の技術】図３に薄膜磁気ヘッドの断面図を示す。この種の薄膜磁気ヘッドは、基板１と第１の絶縁層２の上に形成された下部磁極３の上にスパイラル状パターンを形成する導体コイル７と、それと鎖交するように配置された上部磁極９とからなる。導体コイルパターン間、導体コイル７と下部及び上部磁極３，９間には無機絶縁層４が形成され、導体コイル７およびそれらと鎖交する上部下部磁極３，９を電気的に絶縁しかつ、機械的に支持している。

【０００３】なお、８は、磁気ギャップ，１０は、信号電流のためのコイル端子引出し線である。

【０００４】従来の薄膜磁気ヘッドの製造方法を、図４(a) ～(h) を参考にして説明する。このような薄膜磁気ヘッドの製造方法としては、基板１の絶縁層２上に下部磁極３を形成した後、無機絶縁材で下部磁極３を埋め込み絶縁層４を形成する(a) 。その上に導体コイルメッキ用の導体下地層１３を形成した後、導体コイル７の反転パターン１２をフォトレジスト等で形成する(b) 。その後、電解メッキにより反転パターン１２をフレームとして導体コイル７を所望の膜厚に形成し(c) 、フレーム及び導体コイルメッキ用の導体下地層１３を除去する(d) 。次に無機絶縁材をスパッタリング成膜し導体コイル７を埋め込む(e) 。その後フロントギャップ、バックギャップ部をテーパーエッチングし、フロントギャップ部にギャップ層８を形成する(f) 。上部磁極９形成後(g) 、トラック幅相当分の磁極を上部下部磁極一括でエッチングし（図示せず）、コイル端子引出し線１０を形成することで薄膜磁気ヘッドが形成される(h) 。

【０００５】

【発明が解決しようとする課題】ところが、磁気ヘッドの再生感度向上の要求を達成するため、導体コイル巻き数を増やし、かつ導体コイル抵抗値の低減を行う必要があり、導体コイル形成ピッチを狭め導体コイル厚を厚くすることが求められてきた。しかし、導体コイル７を無機絶縁材で埋め込む場合、スパッタリング等の膜形成技術を用いるため空洞が発生しない埋め込み可能な最大の導体コイル厚と最小のコイル形成間隔は、導体コイル厚のコイル形成間隔に対する比がほぼ１対１の時である。すなわち図５，図６の導体コイルの埋め込み過程等の断面図に示すように、導体コイル厚が図５(a) から図５(b) に例示するごとくＴａからＴｂと厚くなると、導体コイル７を絶縁材１４で埋め込む場合、図５(c) ～(e) に示すように、導体コイル７，７間に無機絶縁材１４のない空洞部１１が発生してしまう。また、図６(a) から図６(b) に例示するごとく導体コイル間隔がＰａからＰｂへと狭くなった場合も、図６(c) ～(e) に示すように、導体コイル間を無機絶縁材１４で埋め込む過程において導体コイル７，７間に無機絶縁材１４のない空洞部１１が生じてしまう。このように再生感度向上の要求のためにコイル厚を厚くしたり、コイル形成ピッチを狭め、導体コイル厚の導体コイル間隔に対する比を１以上にすると、薄膜磁気ヘッドの素子内部に空洞部が存在することとなり機械的強度が弱く、磁気ヘッドとしての信頼性に乏しくなる。

【０００６】

【課題を解決するための手段】本発明では、上記課題を解決するために、導体コイルを一度にスパッタ等によって無機絶縁材で埋め込まずに、予め無機絶縁層中に形成された溝内に導体コイルの一部をメッキで形成し、スパッタによって無機絶縁材で埋め込むべき、コイル高さが実際のコイル高さよりも、低くて済む手段を用いる。

【０００７】具体的には、(イ) 下部磁極を無機絶縁材で埋め込んだ後、該無機絶縁材を導体コイルの反転パターンにエッチングする工程と、(ロ) 上記(イ) 記載の反転パターンに重ねて、ネガ型レジストを用いる反転パターンを形成する工程と、(ハ) 上記(イ)，(ロ) 記載の反転パターンをフレームとしてメッキ法により導体コイルを、

(１) 導体コイルの厚さを該無機絶縁層に形成された導体コイルの反転パターンの溝部の深さより厚く、

(２) かつ、該溝部深さよりも厚く形成された導体コイルの溝部よりも突出した部分の厚さの導体コイル間隔に

対する比を１以下に形成する工程と、(c) 該溝部深さより厚く形成された導体コイルの溝部よりも突出した部分をスパッタ法により無機絶縁材で埋め込む工程とによって、コイル間の無機絶縁材の空洞の形成を阻止して、空洞のない無機絶縁層を有する薄膜磁気ヘッドの製造方法を提供する。

【０００８】

【作用】上記解決手段を採用することにより、

❶図７に示すように無機絶縁材をスパッタすることによって埋め込むべきコイルの高さＢが、実際のコイルの高さＴよりも低くて済む。

❷また、無機絶縁材をスパッタすることによって埋め込むべきコイルの部分は、その高さの隣接する導体コイル間隔に対する比が１以下であるため、このコイルの部分を無機絶縁材の空洞を生ずることなく、スパッタによって埋め込むことが可能となる。

❸さらに、前述のように、メッキ用のフレームの一部としてネガ型レジストを用いるため、図８(a) ～(d) の導体コイル形成工程の概念図に示すように、導体コイルの断面は樽型となる。従って、スパッタによって導体コイルを埋め込むことが、さらに容易となる。

【０００９】ここで、メッキ用フレームのネガ型レジストを用いた部分が逆テーパ状となるのは、露光用マスクから入光する光の拡散による露光部が現像時に溶解するネガ型レジストの特性による。

【００１０】

【実施例】本発明の薄膜磁気ヘッドの製造方法を適用した例を、図１(a) ～(f) 、図２(a) ～(d) を用いて説明する。

【００１１】まず、基板１の第１の絶縁層２上に下部磁極３を形成した後、第２の無機絶縁層４で下部磁極３を埋め込み上部面を平坦架する（図１(a) ）。この時、下部磁極３からの第２の無機絶縁層４の厚さＤは、目標導体コイル７の絶縁がとれる厚さの和に設定する。次に、第２の無機絶縁層４上にポジ型レジスト５を塗布し、導体コイル反転パターンを露光、現像し、マスクパターンを（図１(b) ）のように製作する。マスクパターン製作後、イオンミリングににによって第２の無機絶縁層４を目標深さ分エッチングして、図１(C) のように、導体コイル反転パターンを第２の無機絶縁層４に形成する。導体コイル反転パターン形成用のマスク５を除去後、導体コイル形成のためにコイルメッキ用下地膜１３を成膜する。その後、ネガ型レジストを第２の無機絶縁層上に塗布し、導体コイルメッキ用のフレームパターンを露光、現像しフレーム６を図１(d) のように製作する。次に、電解メッキを行いCuコイルを所定の膜厚に形成し（図１(e) ）、その後フレーム６を除去する。フレーム除去後フレームの下にあったコイルメッキ用下地膜１３をリミングまたはケミカルエッチングで除去する（図１(f) ）。その後スパッタ成膜で無機絶縁材を導体コイル間に埋め込み、上部面をバイアススパッタ等で平坦化する（図２(a) ）。その後フロントギャップ、バックギャップ部をテーパーエッチングする（図２(b) ）。フロントギャップ部にギャップ層８を形成し、上部磁極９を形成後、上部下部磁極３，４のギャップ部でのずれをなくすため、トラック幅相当分の磁極を上部下部磁極一括でエッチングし（図２(c) ）、コイル端子引出し線１０を形成することで薄膜磁気ヘッドが形成される（図２(d) ）。

【００１２】

【発明の効果】本発明により、薄膜磁気ヘッドの導体コイルの厚さを厚くすることによって、また、導体コイル間隔を小さくすることによって、隣接する導体コイル間隔に対する導体コイル厚の比が１以上になっても、コイル間に空洞部を生ずることなく、無機絶縁材によるコイル埋め込みが可能となる。

【００１３】このようにコイル間の空洞の発生を阻止することにより、機械的強度が十分で、かつ、導体コイルの巻き数が多く、電気抵抗値が低い高記録能力を有する薄膜磁気ヘッドの製造が可能となる。

【図面の簡単な説明】

【図１】　本発明の実施例を説明する薄膜磁気ヘッドの導体コイル形成完了までの製造工程図

【図２】　本発明の実施例を説明する薄膜磁気ヘッドの導体コイル形成完了後からウエハプロセス完了までの製造工程図

【図３】　薄膜磁気ヘッドの完成断面図

【図４】　従来例を説明する薄膜磁気ヘッドの製造工程図

【図５】　薄膜磁気ヘッドの導体コイル厚が厚くなった場合の導体コイルの絶縁材埋め込み工程の概念図

【図６】　薄膜磁気ヘッドの導体コイル間隔が小さくなった場合の導体コイルの絶縁材埋め込み工程の概念図

【図７】　本発明の作用を説明する薄膜磁気ヘッドの導体コイル形成工程の概念図

【図８】　本発明の作用を説明する薄膜磁気ヘッドの導体コイル形成工程の概念図

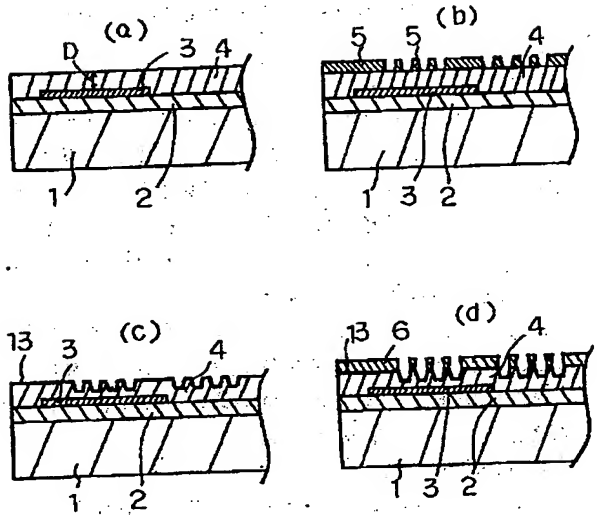
【符号の説明】

１　薄膜磁気ヘッド基板
２　第１の絶縁層
３　下部磁極
４　第２の無機絶縁層
５　無機絶縁層にコイル反転パターンを施すためのポジ型レジストマスク材
６　コイルメッキ用のネガ型レジスト製フレーム
７　導体コイル
８　ギャップ
９　上部磁極
１０　コイル端子引出し線
１１　導体コイル間に発生したっ空洞

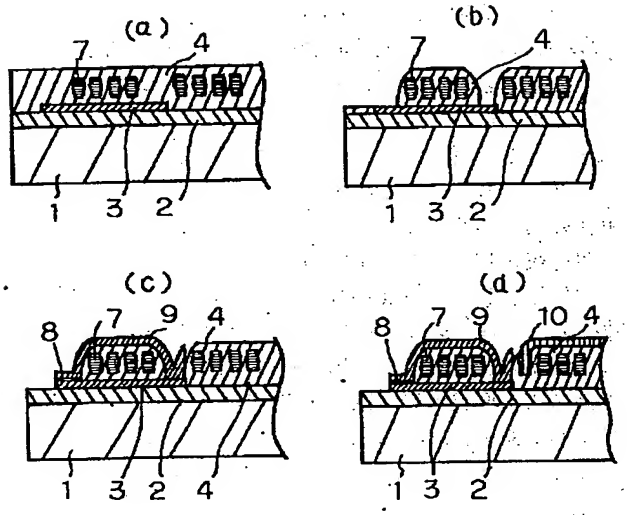
１２　コイルメッキ用のフレーム
１３　コイルメッキ用の下地膜
１４　無機絶縁材
Ｔ　導体コイル膜厚

Ｔａ　導体コイル膜厚（薄い場合）
Ｔｂ　導体コイル膜厚（厚い場合）
Ｐａ　導体コイル間隔（小さい場合）
Ｐｂ　導体コイル間隔（大きい場合）

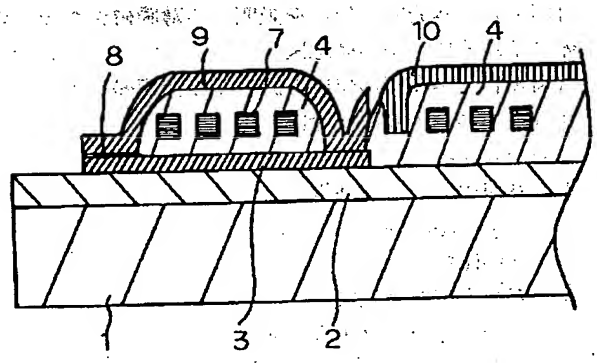
【図１】



【図２】

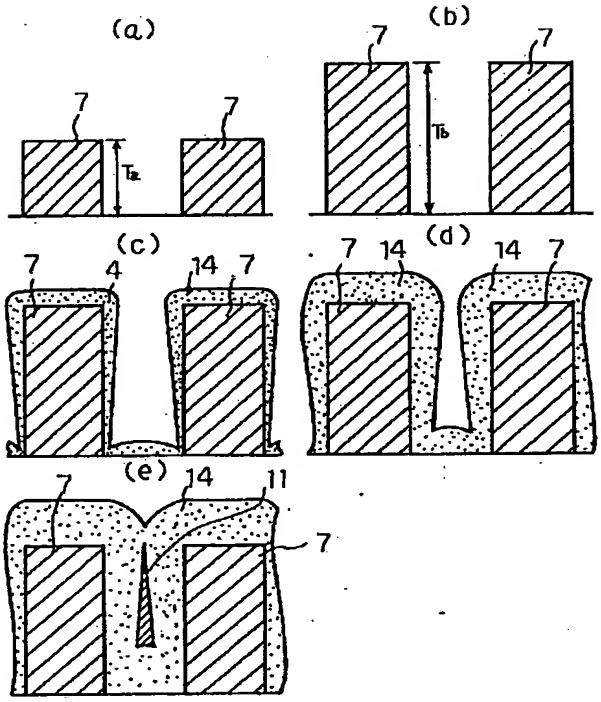


【図３】

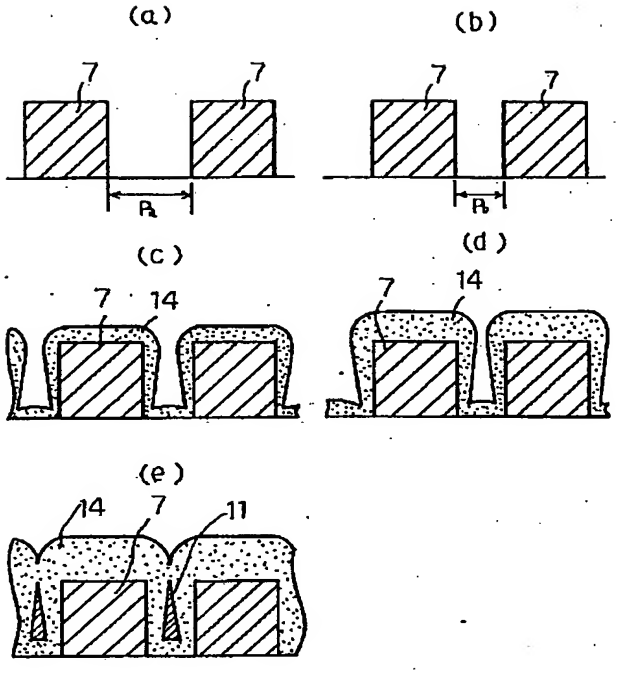


【図４】

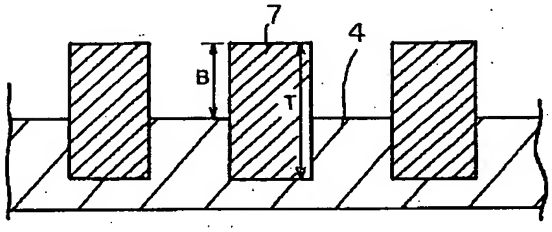
【図５】



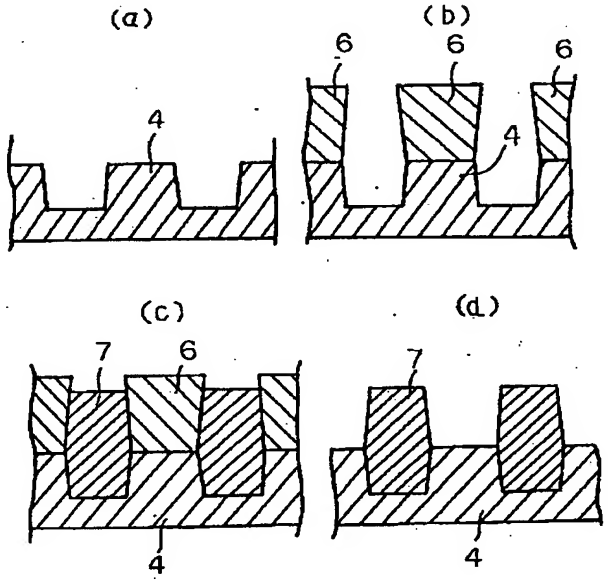
【図６】



【図７】



【図８】



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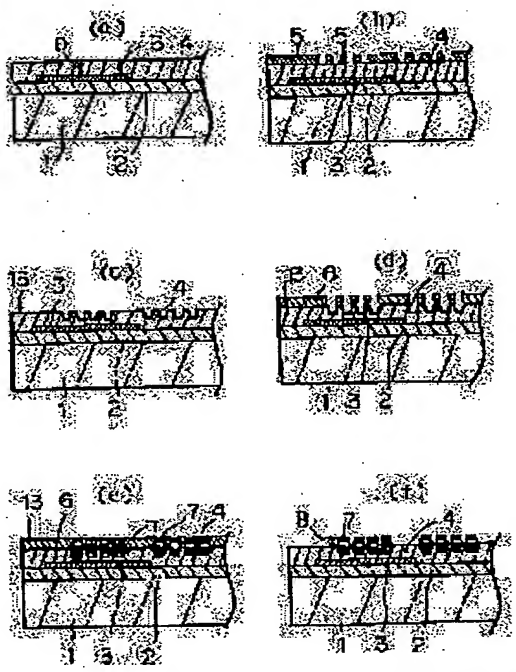
(72)Inventor : HASHIMOTO TADASHI

(54) MANUFACTURE OF THIN FILM MAGNETIC HEAD

(57)Abstract:
PURPOSE: To eliminate generation of a void by facilitating embedding of a thick film of coil with an inorganic insulating material, etc., in a manufacturing method of a thin film magnetic head.
CONSTITUTION: After a lower part magnetic pole 3 is embedded with an inorganic insulation layer 4, an inversion pattern of a conductive coil is applied on the inorganic insulation layer 4 and also a frame 6 for plating for forming the conductive coil is formed using a negative type resist and the thickness of the conductive coil 7 is formed larger than the depth of a recessed part of the coil inversion pattern of the inorganic insulates layer. Thus even if a coil shape of the thin film magnetic head has a narrower interval and a thicker film thickness, embedding of the insulation material between the coils is enabled and reproducing sensitivity of the thin film magnetic head is enhanced.



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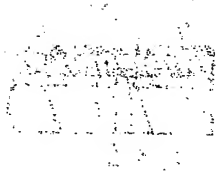

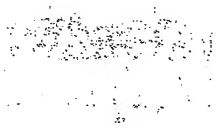

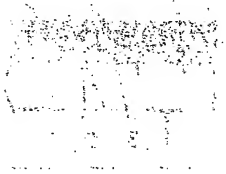

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] In the manufacture approach of the thin film magnetic head of having a coil the inorganic insulating layer inserted into the up magnetic pole and lower magnetic pole on a substrate, and a conductor — (a) the inorganic this insulating material after embedding a lower magnetic pole with an inorganic insulating material — a conductor — with the process etched into the reverse pattern of a coil (b) Above (a) The process which the same pattern as the reverse pattern of a publication is made in agreement with this pattern, and forms it using negative resist, (c) a reverse pattern given in the above (a) and (b) — a frame — carrying out — a conductor — the manufacture approach of the thin film magnetic head characterized by having the process which forms a coil with plating.
[Claim 2] the manufacture approach of the thin film magnetic head according to claim 1 — setting — a conductor — — the conductor of the thickness of a coil — the ratio to coil to coil distance — one or more conductors — a coil — — (a) Thicker than the depth of the slot of the reverse pattern of a coil a conductor — the conductor formed in this inorganic insulating layer in the thickness of a coil — (b) the conductor of this inorganic insulating layer — the conductor formed more thickly than the slot of the reverse pattern of a coil — the conductor of the thickness of the part which projected rather than the slot of a coil — the manufacture approach of the thin film magnetic head characterized by plating and forming the ratio to coil to coil distance or less in one.
[Claim 3] the conductor formed more thickly than the slot depth according to claim 2 — the manufacture approach of the thin film magnetic head characterized by embedding the part which projected rather than the slot of a coil with an inorganic insulating material by the spatter.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the manufacture approach of the thin film magnetic head.
[0002]
[Description of the Prior Art] The sectional view of the thin film magnetic head is shown in drawing 3 . the conductor with which this kind of thin film magnetic head forms a spiral-like pattern on the lower magnetic pole 3 by which it was formed on a substrate 1 and the 1st insulating layer 2 — it consists of a coil 7 and an up magnetic pole 9 arranged so that it may interlink with it. a conductor — between coil patterns and a conductor — the inorganic insulating layer 4 forms between a coil 7, the lower part and the up magnetic pole 3, and 9 — having — a conductor — the up lower magnetic poles 3 and 9 interlinked with a coil 7 and them are insulated electrically, and it is supporting mechanically.
[0003] In addition, 8 is a magnetic gap and 10 is an end-winding child leader for the signal current.
[0004] About the manufacture approach of the conventional thin film magnetic head, it is drawing 4 (a). - (h) It explains by making it reference. It is (a) which embeds the lower magnetic pole 3 with an inorganic insulating material, and forms an insulating layer 4 as the manufacture approach of such the thin film magnetic head after forming the lower magnetic pole 3 on the insulating layer 2 of a substrate 1. . moreover — a conductor — the conductor for coil plating — the conductor after forming the substrate layer 13 — (b) which forms the reverse pattern 12 of a coil 7 by a photoresist etc. . then, electrolytic plating — a reverse pattern 12 — a frame — carrying out — a conductor — the thickness of a request of a coil 7 — forming — (c) a frame and a conductor — the conductor for coil plating — (d) which removes the substrate layer 13 . next, an inorganic insulating material — sputtering membrane formation — carrying out — a conductor — (e) embedding a coil 7 . (f) which carries out taper etching of a front gap and the back gap section after that, and forms the gap layer 8 in the front gap section . It is (g) after up magnetic pole 9 formation. (h) in which the thin film magnetic head is formed by etching the magnetic pole of the width of recording track by up lower magnetic pole package (not shown), and forming the end-winding child leader 10 .
[0005]
[Problem(s) to be Solved by the Invention] in order [however,] to attain the demand of the improvement in playback sensibility of the magnetic head — a conductor — the increase of the number of coiling — carrying out — and a conductor — reduction of coil resistance — it is necessary to carry out — a conductor — a coil formation pitch — narrowing — a conductor — thickening coil thickness has been called for. however, a conductor — the greatest conductor which a cavity does not generate in order to use film formation techniques, such as sputtering, when embedding a coil 7 with an inorganic insulating material and in which embedding is possible — coil thickness and the minimum coil formation spacing — a conductor — it is a time of the ratio to coil formation spacing of coil thickness being about 1 to 1. namely, the conductor of drawing 5 and drawing 6 — it is shown in sectional views, such as an embedding process of a coil, — as — a conductor — coil thickness — drawing 5 (a) from — drawing 5 (b) it illustrates — as — Ta from — Tb if it becomes thick — a conductor — the case where a coil 7 is embedded with an insulating material 14 — drawing 5 (c) - (e) it is shown — as — a conductor — a coil 7 and the cavernous section 11 which does not have the inorganic insulating material 14 among seven will occur. moreover, drawing 6 (a) from — drawing 6 (b) it illustrates — as — a conductor — coil to coil distance — Pa from — Pb the case where it becomes narrow — drawing 6 (c) - (e) it is shown — as — a conductor — the process which embeds between coils with the inorganic insulating material 14 — setting — a conductor — a coil 7 and the cavernous section 11 which does not have the inorganic insulating material 14 among seven will arise. thus — thickening coil thickness for the demand of the improvement in playback sensibility **** — a coil formation pitch — narrowing — a conductor — the conductor of coil thickness — if the ratio to coil to coil distance is made or more into one, the cavernous section will exist in the interior of the component of the thin film magnetic head, and a mechanical strength will be weak and will become scarce at the dependability as the magnetic head.
[0006]
[Means for Solving the Problem] in order to solve the above-mentioned technical problem in this invention — a conductor — Mizouchi beforehand formed into the inorganic insulating layer of the spatter etc. at once in the coil, without embedding with an inorganic insulating material — a conductor — some coils are formed by plating and the means which is lower than the coil height with actual coil height which should be embedded with an inorganic insulating material, and ends by the spatter is used.

[0007] concrete — (b) the inorganic this insulating material after embedding a lower magnetic pole with an inorganic insulating material — a conductor — with the process etched into the reverse pattern of a coil (b) The above-mentioned (b) The process which forms the reverse pattern which uses negative resist for the reverse pattern of a publication in piles, (Ha) The above-mentioned (b) and (b) the reverse pattern of a publication — a frame — carrying out — plating — a conductor — a coil (1) Thicker than the depth of the slot of the reverse pattern of a coil a conductor — the conductor formed in this inorganic insulating layer in the thickness of a coil — (2) and the conductor formed more thickly than this slot depth — the conductor of the thickness of the part which projected rather than the slot of a coil — with the process which forms the ratio to coil to coil distance or less in one (d) the conductor formed more thickly than this slot depth — according to the process which embeds the part which projected rather than the slot of a coil with an inorganic insulating material by the spatter, formation of the cavity of the inorganic insulating material between coils is prevented, and the manufacture approach of the thin film magnetic head of having an inorganic insulating layer without a cavity is offered.

[0008]

[Function] By adopting the above-mentioned solution means, height B of the coil which should be embedded by carrying out the spatter of the inorganic insulating material as shown in ** drawing 7 is lower than height T of a actual coil, and ends.

** the conductor with which, as for the part of the coil which should be embedded by carrying out the spatter of the inorganic insulating material again, that height adjoins — since the ratio to coil to coil distance is one or less, it becomes possible to embed the part of this coil by the spatter, without producing the cavity of an inorganic insulating material.

** in order to use negative resist as a part of frame for plating still as mentioned above — drawing 8 (a) - (d) a conductor — it is shown in the conceptual diagram of a coil formation process — as — a conductor — the cross section of a coil serves as a slack type. therefore, a spatter — a conductor — it becomes still easier to embed a coil.

[0009] The exposure section by the diffusion of light which carries out ON light from the mask for exposure depends on the property [that the part using the negative resist of the frame for plating becomes back taper-like here] of the negative resist dissolved at the time of development.

[0010]

[Example] About the example which applied the manufacture approach of the thin film magnetic head of this invention, it is drawing 1 (a). - (f) Drawing 2 (a) - (d) It uses and explains.

[0011] First, after forming the lower magnetic pole 3 on the 1st insulating layer 2 of a substrate 1, the lower magnetic pole 3 is embedded by the 2nd inorganic insulating layer 4, and the flat rack of the up side is carried out (drawing 1 (a)). this time — thickness D of the 2nd inorganic insulating layer 4 from the lower magnetic pole 3 — a target — a conductor — it is set as the sum of the thickness which can take an insulation of a coil 7. next, the inorganic 2nd insulating-layer 4 top — a positive resist 5 — applying — a conductor — a coil reverse pattern — exposure — developing negatives — a mask pattern — (— it manufactures like drawing 1 (b)). resemble ion milling after a mask pattern fabrication — the 2nd inorganic insulating layer 4 — a part for the target depth — etching — drawing 1 (C) like — a conductor — a coil reverse pattern is formed in the 2nd inorganic insulating layer 4. a conductor — the conductor after removing the mask 5 for coil reverse-pattern formation — the substrate film 13 for coil plating is formed for coil formation. then, negative resist — an inorganic 2nd insulating-layer top — applying — a conductor — the frame pattern for coil plating — exposure — developing negatives — a frame 6 — drawing 1 (d) It manufactures like. Next, electrolytic plating is performed, Cu coil is formed in predetermined thickness (drawing 1 (e)), and a frame 6 is removed after that. The substrate film 13 for coil plating which suited under the frame after frame clearance is removed by RIMINGU or chemical etching (drawing 1 (f)). after that spatter membrane formation — an inorganic insulating material — a conductor — it embeds between coils and flattening of the up side is carried out by a bias spatter etc. (drawing 2 (a)). Taper etching of a front gap and the back gap section is carried out after that (drawing 2 (b)). The gap layer 8 is formed in the front gap section, after forming the up magnetic pole 9, in order to lose the gap by the gap section of the up lower magnetic poles 3 and 4, the magnetic pole of the width of recording track is etched by up lower magnetic pole package (drawing 2 (c)), and the thin film magnetic head is formed by forming the end-winding child leader 10 (drawing 2 (d)).

[0012]

[Effect of the Invention] this invention — the conductor of the thin film magnetic head — thickening thickness of a coil — moreover, a conductor — the conductor which adjoins by making coil to coil distance small — the conductor to coil to coil distance — the coil embedding by the inorganic insulating material becomes possible, without producing the cavernous section between coils, even if the ratio of coil thickness becomes one or more.

[0013] thus, the thing for which generating of the cavity between coils is prevented — a mechanical strength — enough — coming out — and a conductor — there are many numbers of turns of a coil and the manufacture of the thin film magnetic head in which an electric resistance value has low high record capacity of them is attained.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] the conductor of the thin film magnetic head explaining the example of this invention — production process drawing to the completion of coil formation
[Drawing 2] the conductor of the thin film magnetic head explaining the example of this invention — production process drawing from after the completion of coil formation to wafer process completion
[Drawing 3] The completion sectional view of the thin film magnetic head
[Drawing 4] Production process drawing of the thin film magnetic head explaining the conventional example
[Drawing 5] the conductor of the thin film magnetic head — a conductor when coil thickness becomes thick — the conceptual diagram of the insulating material embedding process of a coil
[Drawing 6] the conductor of the thin film magnetic head — a conductor when coil to coil distance becomes small — the conceptual diagram of the insulating material embedding process of a coil
[Drawing 7] the conductor of the thin film magnetic head explaining an operation of this invention — the conceptual diagram of a coil formation process
[Drawing 8] the conductor of the thin film magnetic head explaining an operation of this invention — the conceptual diagram of a coil formation process
[Description of Notations]
1 Thin Film Magnetic-Head Substrate
2 1st Insulating Layer
3 Lower Magnetic Pole
4 2nd Inorganic Insulating Layer
5 Positive-Resist Mask Material for Giving Coil Reverse Pattern to Inorganic Insulating Layer
6 Frame made from Negative Resist for Coil Plating
7 Conductor — Coil
8 Gap
9 Up Magnetic Pole
10 End-Winding Child Leader
11 Conductor — between Coils — **********
12 Frame for Coil Plating
13 Substrate Film for Coil Plating
14 Inorganic Insulating Material
T a conductor — coil thickness
Ta a conductor — coil thickness (when thin)
Tb a conductor — coil thickness (when thick)
Pa a conductor — coil to coil distance (when small)
Pb a conductor — coil to coil distance (when large)

[Translation done.]

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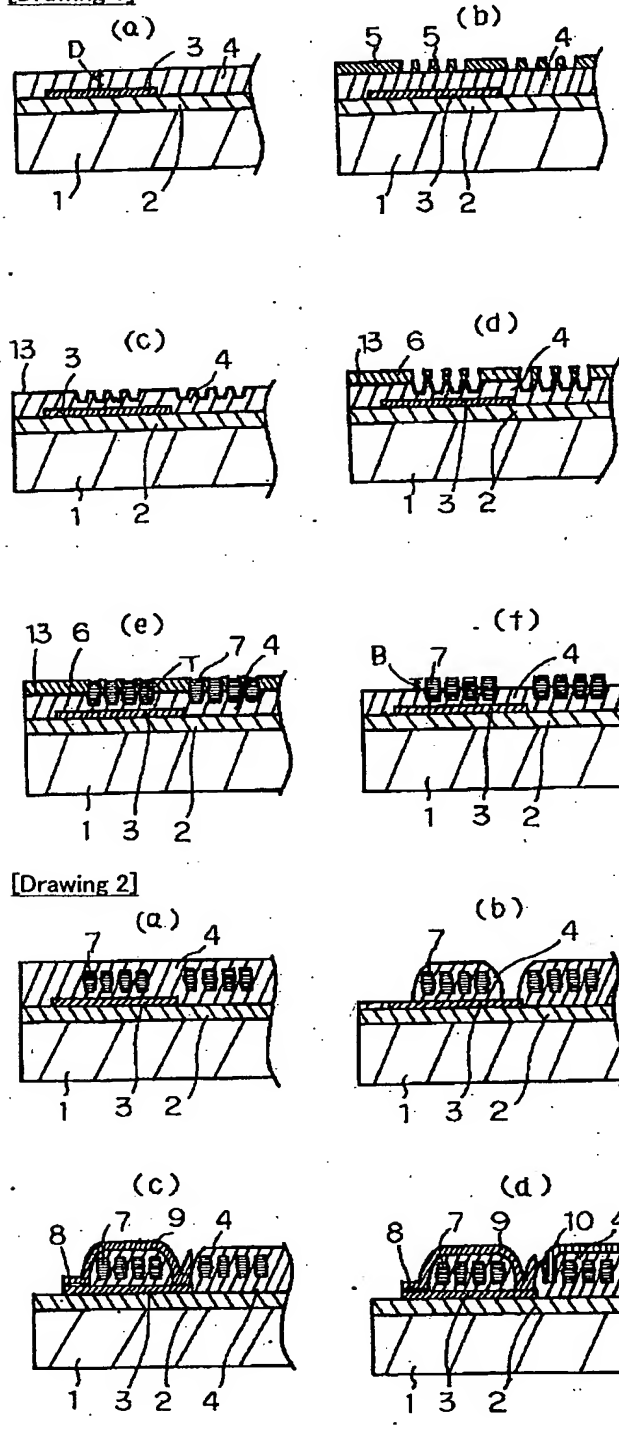
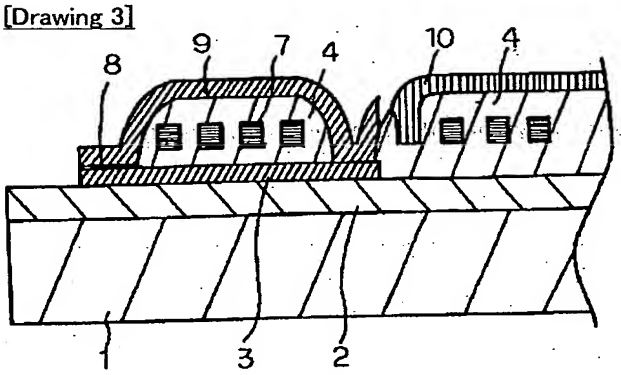
DRAWINGS

[Drawing 1]

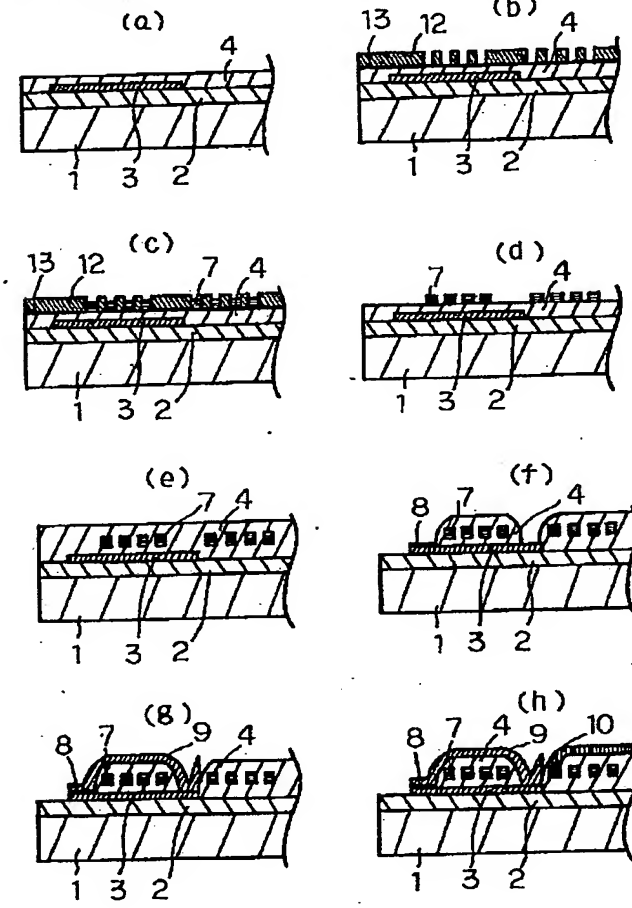


[Drawing 2]

[Drawing 3]



[Drawing 4]



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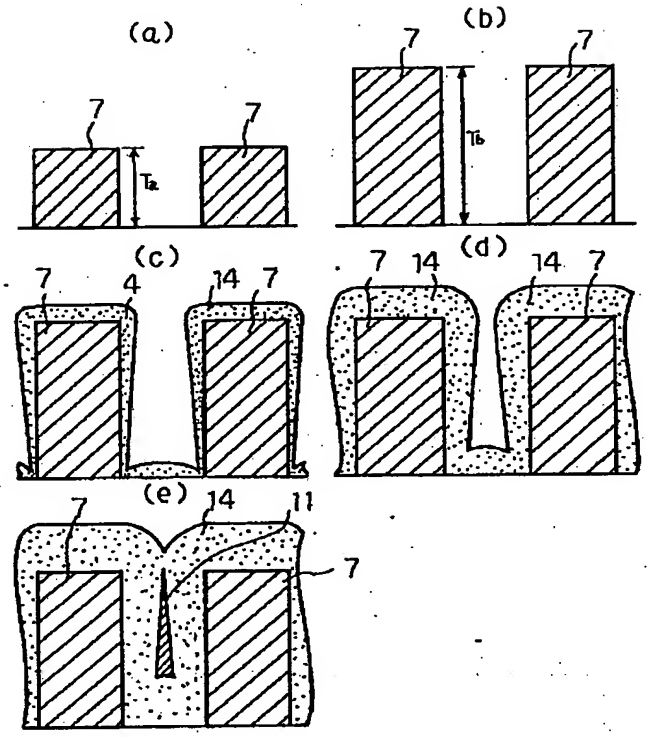

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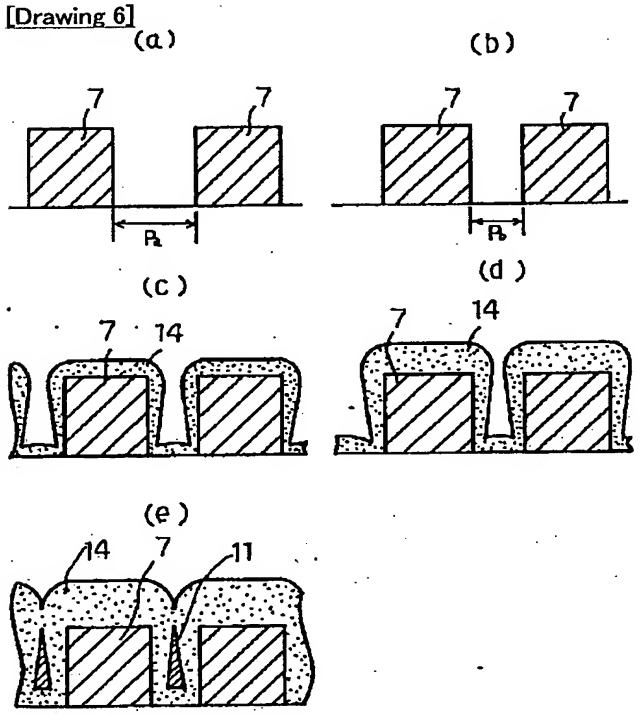

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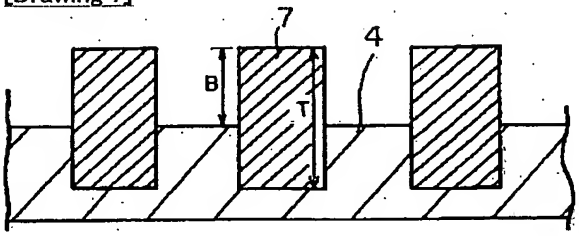
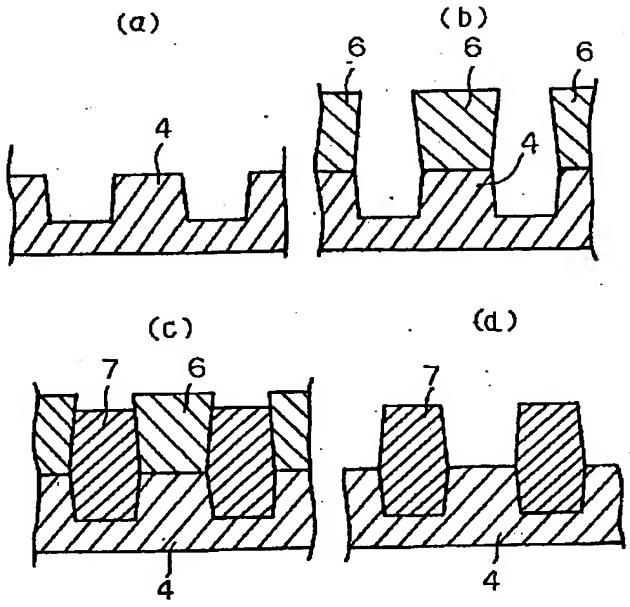


[Drawing 8]



[Translation done.]